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Description**BACKGROUND OF THE INVENTION****5 Field of the Invention**

The present invention relates to a surface-coated cutting member in which the bonding of a hard coating to a substrate is enhanced so highly that the hard coating is hardly subjected to separation, thereby exhibiting excellent wear-resistance over a prolonged period of time.

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Prior Art

There have been extensively used surface-coated cutting members each of which comprises a substrate made of a hard material of tungsten carbide-based cemented carbide, titanium carbo-nitride based cermet or high speed steel, and a hard coating formed on a surface of the substrate and comprising one or more layers each composed of one or more of carbide of metal in Groups IVa, Va or VIa of the Periodic Table, nitride of metal in groups IVa or Va of the Periodic Table, oxide of metal in Group IVa of the Periodic Table, and solid solution of two or more of these compounds.

Each conventional cutting member mentioned above, however, has been found that the bonding of the hard coating to the substrate is not sufficient. Consequently, when the cutting member is used to carry out a heavy-duty cutting operation such as high-speed cutting, high-feed cutting, deep cutting and the like, the hard coating is subjected to separation or wear after a relatively short time to result in a short tool life of the cutting member.

US-4 337 300 discloses a hard-coated cutting blade obtained by applying a bonding layer of Ti-metal on a substrate of high speed steel and by depositing on top of said Ti-layer at least one Ti-compound selected from TiC, TiCN, TiN, TiCNO.

The cutting members of US-4 450 205 show a similar composition, wherein the substrate however is selected from a tungsten carbide-based hard metal.

According to the present invention, there is provided a surface-coated cutting member comprising :

(a) a substrate of hard material selected from the group consisting of tungsten carbide-based cemented carbide, titanium carbo-nitride based cermet and high speed steel;

(b) a layer of metal, vapor deposited on a surface of the substrate; and

(c) a hard coating, vapor deposited on the metal layer, characterized in that said metal layer has an average thickness of 0.1 to 1 μm , and the metal of said metal layer is selected from the group consisting of zirconium and hafnium, said hard coating having an average thickness of 1 to 9 μm and consisting of an inner layer of an average thickness of 0.2 to 4 μm vapor deposited on the metal layer, an intermediate layer of an average thickness of 0.2 to 4 μm vapor deposited on the inner layer and an outer layer of an average thickness of 0.2 to 3 μm vapor deposited on the intermediate layer, said inner layer being made of carbide of metal selected from group (IVa) of the periodic table or made of such carbo-nitride of metal selected from group (IVa) of the periodic table that an atomic ratio of nitrogen to carbon is less than 0.5, said intermediate layer being made of carbo-nitride of metal selected from group (IVa) of the periodic table, wherein the atomic ratio of nitrogen to carbon in said carbo-nitride of said intermediate layer is not less than 0.5, when said inner layer is made of the carbo-nitride, said outer layer being made of nitride of metal selected from group (IVa) of the periodic table.

In a preferred embodiment the metal constituting the compounds for said hard coating is either zirconium or hafnium.

With this construction, the strength of bonding between the substrate and the metal layer is high, and also the strength of bonding between the metal layer and the hard coating is high. Thus, the strength of bonding of the hard coating to the substrate is substantially enhanced through the metal layer interposed therebetween. The metal positively combines with the substrate. Also, the reason why the strength of bonding between the metal layer and the inner layer of the hard coating is high is that metal element is quite active and that these two layers have common metal elements or similar elements belonging to Group IVa of the Periodic Table.

With the above specific construction, as well as the strength of bonding between the hard coating and the substrate, the strength of bonding between the respective layers of the hard coating is highly enhanced to provide the hard coating which is hardly subjected to separation even in the heavy-duty cutting operation. The reason why the strength of bonding between the respective layers of the hard coating is high is that carbide of the inner layer has higher affinity for the metal of the metal layer while nitride of the outer layer

has lower affinity for the metal, and that the intermediate layer includes both carbon and nitrogen, so that carbo-nitride of the intermediate layer is bonded to the outer and inner layers, respectively, with sufficient strength in the process of physical vapor deposition.

The provision of the respective layers of the hard coating has other advantages. Specifically, the inner layer of metal carbide has an advantage of enhancing the resistance of a cutting edge to flank wear since the metal carbide exhibits such a great hardness as to prevent the coating from being adversely affected by abrasion during cutting operation. The intermediate layer of metal carbo-nitride imparts an increased resistance to crater wear to the cutting edge of the cutting member. Further, by virtue of the provision of the outer layer of metal nitride, the cutting edge of the cutting member becomes more resistant to adhesion since nitride of the outer layer has less affinity for a metal workpiece during cutting operation.

Consequently, the hard coating of the surface-coated cutting member in accordance with the present invention is not subjected to separation, and besides exhibits excellent resistance to flank wear, crater wear and adhesion, to thereby provide excellent wear-resistance over a remarkably prolonged period of time.

In the cutting member of the above structure, the average thickness of the metal layer ranges from 0.1 to 1.0 μm . If the average thickness thereof is less than 0.1 μm , metal in the metal layer changes to metal carbide when vapor-depositing the inner layer of carbide on the metal layer. As a result, there arises such a situation that no metal layer exists actually, so that the hard coating fails to have desired excellent bonding to the substrate. On the other hand, if the average thickness exceeds 1 μm , the cutting member becomes less resistant to wear.

In addition, the average thicknesses of the inner layer, the intermediate layer and the outer layer of the hard coating range from 0.2 to 4 μm , from 0.2 to 4 μm and from 0.2 to 3 μm , respectively. If the average thickness of each layer is less than the lower limit, each layer fails to impart sufficient wear-resistance to the cutting edge as desired. On the other hand, if the average thickness of each layer exceeds the upper limit, crystal particles vapor-deposited in each layer become so large that each layer becomes brittle and less tough, to result in a lower resistance of the cutting edge to fracturing and chipping.

Further, the overall hard coating has an average thickness of 1 to 9 μm . If the average thickness is less than 1 μm , the cutting member fails to have sufficient wear-resistance. On the other hand, if the average thickness exceeds 9 μm , the cutting member becomes less resistant to fracturing and chipping.

Although it is preferable that the inner layer of the hard coating is made of carbide of such metal as titanium, zirconium and hafnium, the inner layer may be made of carbonitride of such metal as long as the content of nitrogen is comparatively small relative to the content of carbon to such an extent that an atomic ratio of the nitrogen to carbon is less than 0.5. In such a case, the hard coating includes two layers of carbo-nitride of metal, but the carbo-nitride of metal of the intermediate layer should be such that the content of nitrogen is large relative to the content of carbon so that the atomic ratio of nitrogen to carbon is practically not less than 0.5.

The invention will now be illustrated by the following examples.

COMPARATIVE EXAMPLE 1

There were prepared, as substrates, members conforming in shape to a cutting member of JIS.SNP 432 (ISO.SNGN 120408) and made of tungsten carbide-based cemented carbide of ISO.P 30. A titanium layer and a hard coating consisting of three layers of titanium compounds were vapor-deposited on each of the substrates by using a conventional physical vapor deposition apparatus to provide surface-coated cutting members 1 to 14 and 1' to 12' as shown in Table 1 (hereinafter referred to as "comparative cutting members").

The comparative cutting members 1 to 14 and 1' to 12' were subjected to a continuous cutting test in a lathe. The conditions for this continuous cutting test were as follows:

Workpiece: a steel bar of a circular cross-section (JIS.SNCM439; Hardness: HB 230)

Cutting speed: 130 m/minute

Feed rate: 0.36 mm/revolution

Depth of cut: 1.5 mm

Time of cutting: 15 minutes

An intermittent cutting test in a lathe was also carried out under the following conditions:

Workpiece: a steel block for engagement with the cutting member (JIS.SNCM439; Hardness: HB 270)

Cutting speed: 100 m/minute

Feed rate: 0.375 mm/revolution

Depth of cut: 3 mm

Time of cutting: 2 minutes

In the continuous cutting test, the width of flank wear and the depth of crater wear were respectively measured. In the intermittent cutting test, it was determined how many cutting members of the same construction out of ten were subjected to chipping.

The results obtained are given in Table 2.

5 As seen from Table 2, the comparative cutting members 1 to 14 exhibited sufficient resistances to both flank and crater wear and were less susceptible to chipping. On the other hand, some of the tested comparative cutting members 1' to 12' exhibited very low resistance to either flank wear or crater wear while others were subjected to chipping many times. Some of the comparative cutting members were even subjected to separation.

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TABLE 1

Kind of cutting member	Metal layer	Average thickness (μm)			Total
		TiC	TiCN	TiN	
	1	2	3	3	
Comparative cutting members	2	0.5	2.0	1.0	3.5
	3	0.6	3.5	0.5	4.2
	4	0.4	2.6	0.2	3.6
	5	0.3	0.6	3.8	4.6
	6	0.5	1.5	2.3	6.7
	7	0.3	0.8	0.3	4.1
	8	0.1	0.2	0.6	1.4
	9	0.2	0.8	0.6	1.7
	10	0.2	0.7	1.0	2.2
	11	0.8	3.3	2.4	7.5
30	12	1.0	3.9	1.7	8.6
	13	0.2	0.6(TiCN)	1.5	3.1
	14	0.4	1.0(TiCN)	1.2	3.6
	1'	-*	2.0	1.1	3.4
Comparative cutting members	2'	1.3*	2.2	0.6	3.3
	3'	0.3	-*	0.6	0.9
	4'	0.3	4.4*	1.7	8.7
	5'	0.4	0.5	-*	1.3
	6'	0.3	2.5	4.3*	8.5
	7'	0.2	0.8	0.8	-*
	8'	0.8	3.2	1.2	3.6*
	9'	0.1	0.2	0.2	0.6*
	10'	0.9	3.8	3.7	1.6
	11'	-*	-*	-*	3.0
45	12'	-*	-*	2.3	2.2

"*" denotes a value deviated from the prescribed range of the invention.

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TABLE 2

5	Kind of cutting member	Continuous cutting		Intermittent cutting
		Width of flank wear (mm)	Depth of crater wear (μm)	Number of chipped cutting members/number of tested cutting members
10	1	0.22	70	0/10
	2	0.10	40	1/10
	3	0.08	50	2/10
	4	0.10	50	1/10
	5	0.14	40	2/10
	6	0.11	30	3/10
	7	0.18	35	2/10
	8	0.29	80	0/10
	9	0.21	80	0/10
	10	0.19	70	0/10
15	11	0.07	25	4/10
	12	0.07	20	5/10
	13	0.10	40	1/10
	14	0.11	40	1/10
	15	0.10	30	2/10
20	1'	separation developed	separation developed	10/10
	2'	0.59	150	5/10
	3'	0.40	100	0/10
	4'	0.07	20	10/10
	5'	0.36	100	1/10
	6'	0.10	25	10/10
	7'	0.35	100	1/10
	8'	0.09	20	10/10
	9'	0.53	120	0/10
	10'	0.07	20	10/10
25	11'	0.49	90	9/10
	12'	separation developed	separation developed	10/10
30	15'	0.29	50	10/10

40 COMPARATIVE EXAMPLE 2

There was prepared, as a substrate, a member conforming in shape to a cutting member of JIS.SNP 432 and made of titanium carbo-nitride based cermet having a chemical composition of 58% TiC-15% TiN-12% Mo_2C -15% Ni. A Ti layer having an average thickness of $0.3 \mu\text{m}$ and a hard coating having an average thickness of $2.2 \mu\text{m}$ and consisting of an inner layer of TiC having an average thickness $1.0 \mu\text{m}$, an intermediate layer of TiCN having an average thickness of $0.7 \mu\text{m}$ and an outer layer of TiN having an average thickness of $0.5 \mu\text{m}$ were vapor-deposited on the substrate by using a physical vapor deposition apparatus to provide a surface-coated comparative cutting member 15.

A further comparative cutting member 15' was prepared according to the above procedure except that 50 the hard coating consisted only of a TiN layer having an average thickness of $2 \mu\text{m}$.

As is the case with Comparative Example 1, the comparative cutting member 15 and the comparative cutting member 15' were subjected to continuous and intermittent cutting tests, respectively. The conditions for the continuous cutting test were the same as those in Example 1 except that the cutting speed was 180 m/minute. On the other hand, the conditions for the intermittent cutting test were as follows:

55 Workpiece: a steel block for engagement with the cutting member (JIS.SNCM439; Hardness HB: 230)
 Cutting speed: 150 m/minute
 Feed rate: 0.19 mm/revolution
 Depth of cut: 2 mm

Time of cutting: 2 minutes

Similarly to the case with Comparative Example 1, the width of flank wear and the depth of crater wear were measured in the continuous cutting test while in the intermittent cutting test, it was determined how many cutting members of the same construction out of ten were subjected to chipping.

5 The results obtained are also given in Table 2.

As seen from Table 2, the comparative cutting member 15 exhibited sufficiently high resistance to both flank and crater wear, and only two of the tested cutting members 15 were subjected to chipping. On the other hand, the comparative cutting member 15' exhibited resistance to flank and crater wear substantially lower than that of the cutting member 15, and all of the tested comparative cutting members 15' were 10 subjected to chipping.

COMPARATIVE EXAMPLE 3

15 There was prepared, as a substrate, a member conforming in shape to a two-flute end mill having a diameter of 8 mm and made of high speed steel (JIS.SKH55). A metal Ti layer having an average thickness of 0.2 μm and a hard coating having an average thickness of 2.9 μm and consisting of an inner layer of TiC having an average thickness 0.9 μm , an intermediate layer of TiCN having an average thickness of 1.2 μm and an outer layer of TiN having an average thickness of 0.8 μm were vapor-deposited on the substrate by using a physical vapor deposition apparatus to provide a surface-coated comparative cutting member 16.

20 As is the case with Comparative Example 2, a comparative cutting member 16' was also prepared according to the above procedure except that the hard coating consisted only of a TiN layer having an average thickness of 3 μm .

Then, the comparative cutting member 16 and the comparative cutting member 16' were subjected to a cutting test under the following conditions:

25 Workpiece: alloyed steel (JIS.SKD61; Hardness: HRC 35)

Cutting speed: 40 m/minute

Feed rate: 0.015 mm/revolution

Depth of cut: 7 mm

In the test, it was determined what was the length of a portion of the workpiece cut by each cutting 30 member until the flank of the cutting member was worn 0.3 mm. The comparative cutting member could cut the workpiece by 37 m, but the comparative cutting member-16' cut it by only 20 m.

EXAMPLE 1

35 Members similar to those described in Comparative Example 1 were prepared as substrates. And a zirconium layer and a hard coating consisting of three layers of metal compounds were vapor-deposited on each of the substrates by using a conventional physical vapor deposition apparatus to provide surface-coated cutting members 17 to 19 as shown in Table 3. For comparison purposes, layers as described in Table 3 were also vapor-deposited on the substrates to provide comparative surface-coated cutting 40 members 17' and 18'.

The cutting members 17 to 19 of this invention and the comparative cutting members 17' and 18' were subjected to a continuous cutting test under the same conditions as those in Comparative Example 1 except that the cutting speed was 140 m/minute and that the time of cutting was 20 minutes. And, an intermittent cutting test was also carried out under the same conditions as those in Comparative Example 1 except that 45 the cutting speed was 120 m/minute and that the feed rate was 0.3 mm/revolution.

Similarly to the case with Comparative Example 1, the width of flank wear and the depth of crater wear were measured in the continuous cutting test while in the Intermittent cutting test, it was determined how many cutting members of the same construction out of ten were subjected to chipping.

50 The results obtained are given in Table 4.

As can be seen from Table 4, each of the cutting members 17 to 19 of this invention exhibited a quite high resistance to both flank and crater wear, and at the most, one tested cutting member was subjected to chipping in the Intermittent cutting test of the cutting members 17 to 19. On the other hand, the Comparative cutting member 17' exhibited an extremely low resistance to crater wear, and seven tested members were subjected to chipping. Further, the comparative cutting member 18 was subjected to fracturing in 5 minutes, and all the tested members were subjected to chipping.

TABLE 3

5	Kind of cutting member	Kind of metal layer & average thickness (μm)		Kind of hard coating & average thickness (μm)		
		Inner layer	Intermediate layer	Outer layer	Total thickness	
10	17	Zr	ZrC	ZrCN	ZrN	
		0.4	1.9	2.3	0.8	5.0
	18	Zr	TiC	TiCN	TiN	
		0.6	2.8	1.5	1.0	5.3
	Cutting members of this invention	19	Zr	ZrCN	ZrCN	ZrN
		0.3	1.5	1.7	1.0	4.2
		20	Hf	HfC	HfCN	HfN
		0.4	1.8	1.5	0.7	4.0
		21	Hf	ZrC	ZrCN	ZrN
20	22	0.4	1.8	2.6	0.9	5.3
		0.6	3.2	2.5	1.2	6.9
		23	Hf	HfCN	HfCN	HfN
	22'	0.3	1.5	2.2	1.1	4.8
		17'	Zr	TiN	TiCN	-
25	18'	1.4*	1.8	1.9	-	3.7
		Zr	TiN	TiCN	-	
		0.3	6.2*	6.7*	-	12.9*
	20'	Hf	ZrCN	ZrN	-	
		1.4*	1.5	0.7	-	2.2
	21'	Hf	TiCN	TiN	-	
		0.4	6.0*	6.8*	-	12.8*
		Hf	HfN	ZrCN	-	
30	22'	0.6	6.4*	6.7*	-	13.1*

35 "**" denotes a value deviated from the prescribed range of the invention.

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TABLE 4

Kind of cutting member	Continuous cutting		Intermittent cutting
	Width of flank wear (mm)	Depth of crater wear (μm)	Number of chipped cutting members/number of tested cutting members
17	0.10	20	1/10
Cutting members of this invention	18 19 20 21 22 23	0.13 0.12 0.08 0.10 0.16 0.10	1/10 0/10 1/10 1/10 3/10 1/10
18'	0.60	150	7/10
Comparative cutting members	18' 20' 21' 22'	fractured in 5 minutes 0.58 160 fractured in 3 minutes fractured in 4 minutes	10/10 8/10 10/10 10/10

EXAMPLE 2

Members similar to those described in Comparative Example 1 were prepared as substrates. And, a hafnium layer and a hard coating consisting of three layers of metal compounds were vapor-deposited on each substrate by using a physical vapor deposition apparatus to provide surface-coated cutting members 20 to 23 as shown in Table 3. For comparison purposes, layers as described in Table 3 were also vapor-deposited on the substrates to provide comparative surface-coated cutting members 20' to 22'.

Similarly to the case with Comparative Example 1, the cutting members 20 to 23 of this invention and the comparative cutting members 20' to 22' were subjected to continuous and intermittent cutting tests. The conditions for the continuous cutting test were the same as those in Comparative Example 1 except that the hardness of the workpiece is 260 and that the cutting speed was 140 m/minute. On the other hand, the conditions for the intermittent cutting test were as follows:

Workpiece: a steel block for engagement with the cutting member (JIS.SNCM439; Hardness HB: 300)

Cutting speed: 110 m/minute

Feed rate: 0.265 mm/revolution

Depth of cut: 2 mm

Time of cutting: 2 minutes

Similarly to the case with Example 1, the width of flank wear and the depth of crater wear were measured in the continuous cutting test while in the intermittent cutting test, it was determined how many cutting members of the same construction out of ten were subjected to chipping.

The results obtained are also given in Table 4.

As can be seen from Table 4, each of the cutting members 20 to 23 of this invention exhibited a quite high resistance to both flank and crater wear, and only one or three tested cutting members were subjected to chipping. On the other hand, the comparative cutting member 20 exhibited an extremely low resistance to crater wear, and in the intermittent cutting test, eight tested members were subjected to chipping. Further, the comparative cutting members 21 and 22 were subjected to fracturing after a short time, and all the tested members were subjected to chipping.

As can be seen from the results of the Comparative Examples 1 to 3 and the Examples 1 and 2 the cutting members of the present invention involving a metal layer of zirconium or hafnium show generally better results in comparison to those of the Comparative Examples 1 to 3 even under the tougher working conditions of the Examples 1 and 2 (cutting speed, feed rate, depth of cut are higher). A much longer

service life can be achieved by the cutting members of the present invention.

Claims

5 1. A surface coated cutting member comprising:

- (a) a substrate of hard material selected from the group consisting of tungsten carbide-based cemented carbide, titanium carbo-nitride based cermet and high speed steel;
- (b) a layer of metal, vapor deposited on a surface of the substrate; and
- (c) a hard coating, vapor deposited on the metal layer,

10 characterized in that said metal layer has an average thickness of 0.1 to 1 μm , and the metal of said metal layer is selected from the group consisting of zirconium and hafnium, said hard coating having an average thickness of 1 to 9 μm and consisting of an inner layer of an average thickness of 0.2 to 4 μm vapor deposited on the metal layer, an intermediate layer of an average thickness of 0.2 to 4 μm vapor deposited on the inner layer and an outer layer of an average thickness of 0.2 to 3 μm vapor deposited on the intermediate layer, said inner layer being made of carbide of metal selected from group (IVa) of the periodic table or made of such carbo-nitride of metal selected from group (IVa) of the periodic table that an atomic ratio of nitrogen to carbon is less than 0.5, said intermediate layer being made of carbo-nitride of metal selected from group (IVa) of the periodic table, wherein the atomic ratio of nitrogen to carbon in said carbo-nitride of said intermediate layer is not less than 0.5, when said inner layer is made of the carbo-nitride, said outer layer being made of nitride of metal selected from group (IVa) of the periodic table.

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2. A surface coating cutting member according to claim 1 characterized in that the metal constituting the compounds for said hard coating is either zirconium or hafnium.

25 Revendications

1. Élément de coupe à revêtement de surface comprenant :

- (a) un substrat de matière dure choisie parmi le groupe comprenant le carbure cémenté à base de carbure de tungstène, le cermet à base de carbo-nitride de titane et l'acier rapide ;
- (b) une couche métallique déposée en phase vapeur sur la surface du substrat ; et
- (c) un revêtement dur déposé en phase vapeur sur la couche de métal,

30 caractérisé en ce que ladite couche de métal a une épaisseur moyenne de 0,1 à 1 μm et le métal de ladite couche métallique est choisi parmi le groupe comprenant le zirconium et l'hafnium, ledit revêtement dur ayant une épaisseur moyenne de 1 à 9 μm et consistant en une couche intérieure d'une épaisseur moyenne de 0,2 à 4 μm déposée en phase vapeur sur la couche de métal, une couche intermédiaire d'une épaisseur moyenne de 0,2 à 4 μm déposée en phase vapeur sur la couche intérieure et une couche extérieure d'une épaisseur moyenne de 0,2 à 3 μm déposée en phase vapeur sur la couche intermédiaire, ladite couche intérieure étant formée de carbure d'un métal choisi parmi le groupe (IVa) du tableau périodique ou étant formée de carbo-nitride d'un métal choisi parmi le groupe (IVa) du tableau périodique de manière telle que le rapport atomique de l'azote au carbone soit inférieur à 0,5, ladite couche intermédiaire étant formée de carbo-nitride d'un métal choisi parmi le groupe (IVa) du tableau périodique, le rapport atomique de l'azote au carbone dans ledit carbonitride de la couche intermédiaire n'étant pas inférieur à 0,5, lorsque la couche intérieure est formée de carbonitride, ladite couche extérieure étant formée de nitride d'un métal choisi parmi le groupe (IVa) du tableau périodique.

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2. Élément de coupe à revêtement de surface selon la revendication 1, caractérisé en ce que le métal constituant les composés dudit métal dur est soit du zirconium, soit de l'hafnium.

60 Patentansprüche

1. Schneidelement mit einer überzogenen Oberfläche, umfassend:

- (a) ein Substrat aus Hartmaterial, ausgewählt aus der Gruppe, bestehend aus Sinterhartmetall auf Basis von Wolframkarbid, Cermet auf Basis von Titancarbonitrid und Schnellstahl;
- (b) eine auf der Substratoberfläche aufgedampfte Metallschicht; und
- (c) einen auf der Metallschicht aufgedampften Hartüberzug,

55 dadurch gekennzeichnet, dass die Metallschicht eine Durchschnittsdicke von 0,1 bis 1 μm aufweist

und das Metall dieser Metallschicht aus der Gruppe aus Zirkonium und Hafnium ausgewählt ist, wobei der Hartüberzug eine Durchschnittsdicke von 1 bis 9 μm aufweist, und aus einer inneren Schicht, die auf die Metallschicht aufgedampft ist, und eine Durchschnittsdicke von 0,2 bis 4 μm aufweist, einer Zwischenschicht, die auf die Innere Schicht aufgedampft ist und eine Durchschnittsdicke von 0,2 bis 4 μm aufweist, und einer äusseren Schicht, die auf die Zwischenschicht aufgedampft ist und eine Durchschnittsdicke von 0,2 bis 3 μm aufweist, besteht, wobei die innere Schicht aus Metallkarbid, dessen Metall aus der Gruppe IVa des Periodensystems ausgewählt ist, besteht, oder aus solchem Metallcarbonitrid, dessen Metall aus der Gruppe IVa des Periodensystems ausgewählt ist, hergestellt worden ist, dass das Atomverhältnis von Stickstoff zu Kohlenstoff kleiner als 0,5 ist, wobei die Zwischenschicht aus Metallcarbonitrid, dessen Metall aus der Gruppe IVa des Periodensystems ausgewählt ist, hergestellt worden ist, wobei das Atomverhältnis von Stickstoff zu Kohlenstoff in dem Carbonitrid der Zwischenschicht nicht weniger als 0,5 ist, wenn die innere Schicht aus Carbonitrid hergestellt worden ist, wobei die äussere Schicht aus Metallnitrid, dessen Metall aus der Gruppe IVa des Periodensystems ausgewählt ist, hergestellt worden ist.

15 2. Schneidelement mit einem Oberflächenüberzug nach Anspruch 1, dadurch gekennzeichnet, dass das Metall, das die Verbindungen für den Hartüberzug bildet, entweder Zirkonium oder Hafnium ist.

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